What needs to be considered when managing the batteries of Kentix devices?

In order to ensure the reliability of battery-operated devices in the SmartMonitoring and SmartAccess areas, special operating and maintenance measures must be observed on the one hand, and on the other hand, a certain basic knowledge of the physical behavior of batteries, especially lithium batteries, is advantageous.
Especially in the SmartAccess area (access control), discharged or empty batteries can lead to considerable functional impairments. Battery-operated devices are therefore not maintenance-free devices.
In principle, all Kentix devices also send information about the state of charge (SoC) and the temperature of the battery with every transmission and booking process. Based on these and various other parameters, a qualitative statement can be made about the state of charge of the battery. Unfortunately, lithium batteries have some non-linear properties (see details in the appendix) that do not allow a 100% reliable statement to be made about the remaining capacity. In addition, there are quality fluctuations in production and among the various manufacturers.
As a rule, the Kentix software provides early information about the discharge in order to initiate a timely battery change. However, deviations, exacerbated by temperature fluctuations and usage behavior, can also lead to very short warning times or direct failures.
Battery-operated devices are very reliable solutions if the measures are known in advance and appropriate precautions have been taken for a quick battery change. The advantage lies in the simple and cost-effective installation and commissioning.

We recommend that you observe the following points when operating Kentix battery devices:

- Where maximum availability is required, battery-operated devices should possibly not be used.
- Where maximum availability is required, a replacement function must be available in addition to the standard function. In the case of access solutions, this is referred to as overlocking with a mechanical emergency key. The legal requirements must be observed here (e.g. access to medical equipment, medication, essential items).
- Regular battery replacement for devices that are exposed to strong temperature fluctuations (hot – cold, summer – winter) (e.g. external doors, cooling systems, etc.).
- Change the battery regularly throughout the year, always before cold periods (e.g. in October before the start of winter) to avoid battery failures as far in advance as possible.
- Document the replacement, note the date on the battery. Enter the maintenance intervals.
- Only use recommended and original battery types, especially industrial types with

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optimized characteristics.
- Observe the operating instructions for the respective device; some of our devices have several signaling levels. In addition to the software, the Kentix SmartAccess components also report battery status locally on the device by means of visual and acoustic messages. Familiarize yourself and your staff with it.

Handling and disposal of lithium-ion batteries:

- Observe the manufacturer’s safety data sheets and instructions
- Follow the instructions for the safe storage and disposal of batteries (e.g. Federal Environment Agency, trade associations, etc.).

Appendix:

Monitoring the capacity of single-cell lithium-ion batteries is difficult for several reasons.

Taken together, these factors result in a combination of non-linear and environmental influencing factors that make accurate capacity monitoring of lithium-ion batteries difficult. Therefore, reliable monitoring often requires a combination of several measurement methods (e.g. voltage, current, temperature and algorithms to estimate the SoC). In our software solutions, we try to evaluate as many of the parameters as possible and guarantee the best possible monitoring. Continuous findings are incorporated into the further development of the software.

Why it is difficult to monitor the capacity of lithium batteries 100%:

1. **Flat voltage curve during discharge:**
   With lithium-ion batteries, the voltage changes only minimally over a large part of the discharge process. This means that it is difficult to make an accurate estimate of the state of charge (SoC) based on the voltage. The voltage remains relatively constant in the middle of the discharge process, so that the voltage alone does not provide any precise information about the current state of charge.
2. **Non-linear discharge characteristics:**
   The voltage and the state of charge (SoC) do not have a simple linear relationship. This non-linearity makes it difficult to develop simple algorithms for capacity monitoring, especially in the event of temperature fluctuations or different discharge currents.
3. **Dependence on temperature and current:**
   The state of charge is influenced by the temperature and the discharge current. At high currents or extreme temperatures, the voltage and capacity measurements can be distorted. This makes it even more complicated to determine the actual state of charge of the battery.
4. **Self-discharge:**
   Lithium-ion batteries discharge themselves over time, even when they are not in use.

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This self-discharge must be included in the monitoring, which further complicates the capacity calculations.

5. **Ageing effects (capacity loss):**
   Over time, a lithium-ion battery ages, resulting in a loss of overall capacity. This capacity loss is not linear and varies greatly depending on operating conditions such as temperature and charging cycles. Monitoring must therefore also take into account the remaining capacity of the ageing cell. As a rule, lithium-ion batteries have a service life of up to 10 years.
6. **Lack of clear state of charge indicators:**
   Unlike other battery technologies, such as nickel-cadmium or lead-acid, lithium-ion batteries do not have clear indicators such as significant voltage drops or changes in the electrode structure that can be easily monitored to accurately determine the state of charge.

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